

Application No. 10/797343

2

Docket No.: P0806.70004US00

**AMENDMENTS TO THE CLAIMS**

1. (Currently Amended) A milling apparatus comprising:  
a media mill; and  
grinding media used in the media mill to mill a product, wherein the [[G]]grinding media are  
shaped suitable for milling the product in the [[a]] media mill, and the grinding media  
comprise[[ing]] a multi-carbide material which includes carbon and at least two different carbide-  
forming metal elements wherein said multi-carbide material is formed into shaped grinding media  
ranging in size from 0.5 micron to 100 mm.
2. (Currently Amended) ~~Grinding media~~The apparatus according to claim 1, wherein said carbide-forming metal elements are selected from the group consisting of chromium, hafnium, molybdenum, niobium, rhenium, tantalum, thallium, titanium, tungsten, vanadium, and zirconium.
3. (Currently Amended) ~~Grinding media~~The apparatus according to claim 1, wherein said grinding media comprise[[s]] a multi-carbide material consisting essentially of carbon and at least two different carbide-forming metal elements wherein said multi-carbide material is formed into shaped grinding media ranging in size from 0.5 micron to 100 mm.
4. (Currently Amended) ~~Grinding media~~The apparatus according to claims 1, 2, or 3 wherein said multi-carbide material further includes a carbide-forming metal element in its elemental state.
5. (Currently Amended) ~~Grinding media~~The apparatus according to claims 1, 2, or 3 wherein said multi-carbide material further includes at least one of said carbide-forming metal elements of said multi-carbide material in its elemental state.
6. (Currently Amended) ~~Grinding media~~The apparatus according to claim 1, wherein said ~~grinding media~~ multi-carbide material consists essentially of titanium, tungsten, and carbon, in the ratios of from about 10 to 90 at% tungsten, from about 2 to 97 at% titanium, and the balance carbon.
7. (Currently Amended) ~~Grinding media~~The apparatus according to claim 1, wherein said ~~grinding media~~ multi-carbide material consists essentially of about 10 to 40 at% carbon; from about 5 to 50 at% titanium, and the balance being tungsten.

1079024.1

Application No. 10/797343

3

Docket No.: P0806.70004US00

8. (Currently Amended) ~~Grinding media~~ The apparatus according to claim 1, ~~further comprising wherein said~~ [[a]] multi-carbide material consisting consists essentially of from about 10 to 40 at% carbon, from about 5 to 50 at% titanium, ~~and the balance being tungsten,[[;]]~~ and at least one material taken from the group consisting of molybdenum, chromium, and rhenium; wherein said at least one material is in an amount from 0 to about 20 at%, with the tungsten remaining in the composition being not less than 10 at%.

9. (Currently Amended) ~~Grinding media~~ The apparatus according to claim 1, ~~comprising a wherein~~ the multi-carbide material consists consisting essentially of from about 20 to 30 at% carbon; from about 5 to 50 at% titanium; from about 0 to 30 at% of at least a first material from the group consisting of rhenium, zirconium, hafnium and molybdenum; from about 0 to 10 at% of at least a second material taken from the group consisting of vanadium, niobium and tantalum; from about 0 to 20 at% chromium; with the balance, but not less than 10 at%, being tungsten.

10. (Currently Amended) ~~Grinding media~~ The apparatus according to claim 1, wherein the grinding media comprise comprising a multi-carbide material consisting essentially of:

(a) from about 15 to 60 at% titanium and first alloying substituents, wherein said first alloying substituents consist of hafnium, niobium, tantalum and zirconium; and wherein titanium, titanium and niobium, or titanium and niobium and tantalum are present from 0 to 20 at%; wherein titanium or titanium and zirconium are present from about 0 to 10 at%; and wherein titanium or titanium and hafnium are present from about 0 to 30 at%; and the balance, if any, being titanium;

(b) from about 3 to 47 at% tungsten and second alloying substituents, wherein said second alloying substituents consist of chromium, molybdenum, vanadium, tantalum and niobium; wherein tungsten or tungsten and chromium are present from about 0 to 5 at%; wherein tungsten or tungsten and molybdenum are present from about 0 to 25 at%; wherein tungsten or tungsten and vanadium are present from about 0 to 5 at%; and wherein tungsten, tungsten and tantalum, tungsten and niobium, or tungsten and tantalum and niobium are present from about 0 to 20 at%; and the balance, if any, being tungsten;

(c) carbon from about 30 to 55 at%; and

1079024.1

Application No. 10/797343

4

Docket No.: P0806.70004US00

(d) wherein the atomic percentages of niobium and tantalum, each alone or in combination, never exceed 20 at%; and

~~(e) wherein the total at% of all constituents is 100 at%, all of the constituents of the alloy being of normal commercial purity.~~

11. (Currently Amended) ~~Grinding media~~ The apparatus according to claims 1, 2, 3, 6, 7, 8, 9, or 10, wherein said ~~shaped grinding media~~ are shaped as spheres.

12-59. (Cancelled)

60. (Currently Amended) A method for milling a product in a media mill, comprising the step of milling a product in a media mill using grinding media, wherein the grinding media comprise ~~comprise~~ a multi-carbide material which includes carbon and at least two carbide-forming metal elements.

61. (Previously Presented) A method according to claim 60, wherein said carbide-forming metal elements are selected from the group consisting of chromium, hafnium, molybdenum, niobium, rhenium, tantalum, thallium, titanium, tungsten, vanadium, and zirconium.

62. (Previously Presented) A method according to claims 60 or 61 wherein said multi-carbide material further includes a carbide-forming metal element in its elemental state.

63. (Previously Presented) A method according to claims 60 or 61 wherein said multi-carbide material further includes at least one of said carbide-forming metal elements of said multi-carbide material in its elemental state.

64. (Currently Amended) A method according to claim 60, wherein said ~~media~~ multi-carbide material consists essentially of titanium, tungsten, and carbon, in the ratios of from about 10 to 90 at% tungsten, from about 2 to 97 at% titanium, and the balance carbon.

65. (Currently Amended) A method according to claim 60, wherein said ~~media~~ multi-carbide material consists essentially of about 10 to 40 at% carbon; from about 5 to 50 at% titanium, and the balance being tungsten.

1079024.1

Application No. 10/797343

5

Docket No.: P0806.70004US00

66. (Currently Amended) A method according to claim 60, wherein said ~~media comprises~~ a multi-carbide material consisting essentially of from about 10 to 40 at% carbon, from about 5 to 50 at% titanium, ~~and the balance being tungsten,~~ and at least one material taken from the group consisting of molybdenum, chromium, and rhenium; wherein said at least one material is in an amount from 0 to about 20 at%, with the tungsten remaining in the composition being not less than 10 at%.

67. (Currently Amended) A method according to claim 60, wherein said grinding media comprise[[s]] a multi-carbide material consisting essentially of from about 20 to 30 at% carbon; from about 5 to 50 at% titanium; from about 0 to 30 at% of at least a first material from the group consisting of rhenium, zirconium, hafnium and molybdenum; from about 0 to 10 at% of at least a second material taken from the group consisting of vanadium, niobium and tantalum; from about 0 to 20 at% chromium; with the balance, but not less than 10 at%, being tungsten.

68. (Currently Amended) A method according to claim 60, wherein said grinding media comprise[[s]] ~~a multi-carbide material consisting essentially of:~~

(a) from about 15 to 60 at% titanium and first alloying substituents, wherein said first alloying substituents consist of hafnium, niobium, tantalum and zirconium; and wherein titanium, titanium and niobium, or titanium and niobium and tantalum are present from 0 to 20 at%; wherein titanium or titanium and zirconium are present from about 0 to 10 at%; and wherein titanium or titanium and hafnium are present from about 0 to 30 at%; and the balance, if any, being titanium;

(b) from about 3 to 47 at% tungsten and second alloying substituents, wherein said second alloying substituents consist of chromium, molybdenum, vanadium, tantalum and niobium; wherein tungsten or tungsten and chromium are present from about 0 to 5 at%; wherein tungsten or tungsten and molybdenum are present from about 0 to 25 at%; wherein tungsten or tungsten and vanadium are present from about 0 to 5 at%; and wherein tungsten, tungsten and tantalum, tungsten and niobium, or tungsten and tantalum and niobium are present from about 0 to 20 at%; and the balance, if any, being tungsten;

(c) carbon from about 30 to 55 at%;

1079024.1

Application No. 10/797343

6

Docket No.: P0806.70004US00

(d) wherein the atomic percentages of niobium and tantalum, each alone or in combination, never exceed 20 at%; and

~~(e) wherein the total at% of all constituents is 100 at%, all of the constituents of the alloy being of normal commercial purity.~~

69. (Currently Amended) A method according to claims 60, 61, 64, 65, 66, 67, or 68, further comprising the step of forming said media into shaped wherein the grinding media range ranging in size from 0.5 micron to 100 mm in diameter.

70. (Currently Amended) A method according to claims 60, 61, 64, 65, 66, 67, or 68, further comprising the step of forming said wherein the grinding media into comprise spheres ranging in size from 0.5 micron to 100 mm in diameter.

71-76. (Cancelled)

77. (Currently Amended) ~~Grinding media~~The apparatus according to claim 1, wherein the grinding media have[[s]] a size of less than 500 micron.

78. (Currently Amended) ~~Grinding media~~The apparatus according to claim 1, wherein the grinding media ha ve[[s]] a density of greater than 8 gm/cc.

79. (Currently Amended) A milling apparatus comprising:

a media mill; and

grinding media used in the media mill to mill a product, wherein the [[G]]grinding media have[[ing]] a substantially spherical shape ~~and suitable for milling product in a media mill~~, the grinding media comprising a multi-carbide material which includes carbon and at least two different carbide-forming metal elements.

80. (Currently Amended) ~~Grinding media~~The apparatus according to claim 79, wherein said carbide-forming metal elements are selected from the group consisting of chromium, hafnium, molybdenum, niobium, rhenium, tantalum, thallium, titanium, tungsten, vanadium, and zirconium.

1079024.1

Application No. 10/797343

7

Docket No.: P0806.70004US00

81. (Currently Amended) ~~Grinding media~~ The apparatus according to claim 79, wherein said grinding media comprises a multi-carbide material consisting essentially of carbon and at least two different carbide-forming metal elements.
82. (Currently Amended) ~~Grinding media~~ The apparatus according to claim 79, wherein the grinding media have[[s]] a size of less than 500 micron.
83. (Currently Amended) ~~Grinding media~~ The apparatus according to claim 79, wherein said multi-carbide material further includes a carbide-forming metal element in its elemental state.
84. (Currently Amended) ~~Grinding media~~ The apparatus according to claim 79, wherein said multi-carbide material further includes at least one of said carbide-forming metal elements of said multi-carbide material in its elemental state.
85. (Currently Amended) ~~Grinding media~~ The apparatus according to claim 79, wherein said ~~grinding media~~ multi-carbide material consists essentially of titanium, tungsten, and carbon, in the ratios of from about 10 to 90 at% tungsten, from about 2 to 97 at% titanium, and the balance carbon.
86. (Currently Amended) ~~Grinding media~~ The apparatus according to claim 79, wherein said ~~grinding media~~ multi-carbide material consists essentially of about 10 to 40 at% carbon; from about 5 to 50 at% titanium, and the balance being tungsten.
87. (Currently Amended) ~~Grinding media~~ The apparatus according to claim 79, wherein the grinding media have[[s]] a density of greater than 8 gm/cc.
88. (Currently Amended) A milling apparatus comprising:  
a media mill; and  
grinding media used in the media mill to mill a product, wherein the [[G]]grinding media are  
shaped suitable for milling the product in [[a]] the media mill, wherein the grinding media  
comprise[[ing]] a multi-carbide material which includes carbon and at least two different carbide-  
forming metal elements wherein the grinding media have[[s]] a size of less than 500 micron.

Application No. 10/797343

8

Docket No.: P0806.70004US00

89. (Currently Amended) ~~Grinding media~~ The apparatus according to claim 88, wherein said carbide-forming metal elements are selected from the group consisting of chromium, hafnium, molybdenum, niobium, rhenium, tantalum, thallium, titanium, tungsten, vanadium, and zirconium.

90. (Currently Amended) ~~Grinding media~~ The apparatus according to claim 88, wherein said grinding media comprise a multi-carbide material consisting essentially of carbon and at least two different carbide-forming metal elements.

91. (Currently Amended) ~~Grinding media~~ The apparatus according to claim 88, wherein the grinding media has a size of greater than 0.5 micron.

92. (Currently Amended) ~~Grinding media~~ The apparatus according to claim 88, wherein said multi-carbide material further includes a carbide-forming metal element in its elemental state.

93. (Currently Amended) ~~Grinding media~~ The apparatus according to claim 88, wherein said multi-carbide material further includes at least one of said carbide-forming metal elements of said multi-carbide material in its elemental state.

94. (Currently Amended) ~~Grinding media~~ The apparatus according to claim 88, wherein said ~~grinding media~~ multi-carbide material consists essentially of titanium, tungsten, and carbon, in the ratios of from about 10 to 90 at% tungsten, from about 2 to 97 at% titanium, and the balance carbon.

95. (Currently Amended) ~~Grinding media~~ The apparatus according to claim 88, wherein said ~~grinding media~~ multi-carbide material consists essentially of about 10 to 40 at% carbon; from about 5 to 50 at% titanium, and the balance being tungsten.

96. (Currently Amended) ~~Grinding media~~ The apparatus according to claim 88, wherein the grinding media have [[s]] a density of greater than 8 gm/cc.

97. (Previously Presented) The method of claim 60, comprising milling the product to a size of less than 100 nanometers.

98. (Previously Presented) The method of claim 60, comprising milling the product to a size of less than 30 nanometers.

1079024.1

Application No. 10/797343

9

Docket No.: P0806.70004US00

99. (Previously Presented) The method of claim 60, comprising milling the product to a size of less than 100 nanometers and a contamination level of less than 800 ppm.

100. (Previously Presented) The method of claim 60, comprising milling the product to a size of less than 100 nanometers and a contamination level of less than 300 ppm.

101. (Previously Presented) The method of claim 60, comprising milling the product to a size of less than 100 nanometers in at least one dimension.

102. (Previously Presented) The method of claim 60, comprising milling catalytic particles to a size of less than 30 nanometers.

103. (Previously Presented) The method of claim 60, comprising milling intermetallic particles to a size of less than 30 nanometers.

104. (Previously Presented) The method of claim 60, comprising milling titania particles to a size of less than 90 nanometers and a contamination level of less than 100 ppm.

105. (Previously Presented) The method of claim 60, comprising milling diamond particles to a size of less than 100 nanometers.

106. (Previously Presented) The method of claim 60, comprising milling semiconductor particles to a size of less than 50 nanometers and a contamination level of less than 200 ppm.

107. (Previously Presented) The method of claim 60, comprising milling silicon carbide particles to a size of less than 1 micron and a contamination level of less than 600 ppm.

108. (Previously Presented) The method of claim 60, comprising milling alumina particles to a size of less than 30 nanometers and a contamination level of less than 600 ppm.

109. (Previously Presented) The method of claim 60, comprising milling tungsten particles to a size of less than 400 nm and a contamination level of less than 900 ppm.

110. (Previously Presented) The method of claim 60, comprising milling molybdenum particles to a size of less than 400 nm and a contamination level of less than 900 ppm.

1079024.1



Application No. 10/797343

10

Docket No.: P0806.70004US00

111. (Previously Presented) The method of claim 60, comprising milling cobalt or cobalt nitride particles to a size of less than 5 microns and a contamination level of less than 500 ppm.
112. (Previously Presented) The method of claim 60, comprising milling metal nitride particles to a size of less than 20 microns and a contamination level of less than 900 ppm.
113. (Previously Presented) The method of claim 60, comprising milling metal hydride particles to a size of less than 300 nm and a contamination level of less than 900 ppm.
114. (New) The apparatus according to claim 1, wherein the multi-carbide material comprises at least tungsten and titanium as the multi-carbide forming elements.
115. (New) The apparatus according to claim 1, wherein the multi-carbide material comprises titanium and/or alloying substituents for titanium, tungsten and/or alloying substituents for tungsten and carbon.
116. (New) The apparatus according to claim 79, wherein the multi-carbide material comprises at least tungsten and titanium as the multi-carbide forming elements.
117. (New) The apparatus according to claim 79, wherein the multi-carbide material comprises titanium and/or alloying substituents for titanium, tungsten and/or alloying substituents for tungsten, and carbon.
118. (New) The apparatus according to claim 88, wherein the multi-carbide material comprises at least tungsten and titanium as the multi-carbide forming elements.
119. (New) The apparatus according to claim 88, wherein the multi-carbide material comprises titanium and/or alloying substituents for titanium, tungsten and/or alloying substituents for tungsten, and carbon.
120. (New) The method of claim 60, wherein the multi-carbide material comprises at least tungsten and titanium as the multi-carbide forming elements.

1078024.1

Application No. 10/797343

11

Docket No.: P0806.70004US00

121. (New) The method of claim 60, wherein the multi-carbide material comprises titanium and/or alloying substituents for titanium, tungsten and/or alloying substituents for tungsten, and carbon.

122. (New) The method of claim 60, comprising milling the product to a size of less than 100 nanometers and a contamination level less than 10 ppm.

123. (New) The method of claim 60, wherein the multi-carbide material comprises:

(a) from about 15 to 60 at% titanium and first alloying substituents, wherein said first alloying substituents consist of hafnium, niobium, tantalum and zirconium; and wherein titanium, titanium and niobium, or titanium and niobium and tantalum are present from 0 to 20 at%; wherein titanium or titanium and zirconium are present from about 0 to 10 at%; and wherein titanium or titanium and hafnium are present from about 0 to 30 at%; and the balance, if any, being titanium;

(b) from about 3 to 47 at% tungsten and second alloying substituents, wherein said second alloying substituents consist of chromium, molybdenum, vanadium, tantalum and niobium; wherein tungsten or tungsten and chromium are present from about 0 to 5 at%; wherein tungsten or tungsten and molybdenum are present from about 0 to 25 at%; wherein tungsten or tungsten and vanadium are present from about 0 to 5 at%; and wherein tungsten, tungsten and tantalum, tungsten and niobium, or tungsten and tantalum and niobium are present from about 0 to 20 at%; and the balance, if any, being tungsten; and

(c) carbon from about 30 to 55 at%.

1079024.1